

Materials Effects of Air Pollution

Research is underway in four areas: 1) Deterioration rates of stone and bronze; 2) *in situ* monitoring of cultural resource degradation; 3) distribution of cultural properties; 4) protection and mitigation strategies. The bulk of the research began in 1983-84.

Deterioration rates of stone are being studied through 10-year field exposure tests at four sites, in cooperation with the Bureau of Mines and EPA, who are sponsoring tests of metals and paints, respectively. These sites are at Research Triangle Park, North Carolina; West End Branch Library, Washington, D.C.; Environmental Measurements Laboratory, Chester, New Jersey; and Huntington Wildlife Forest, Newcomb, New York. A fifth NPS site will be established at Steubenville, Ohio in FY1986. At each site slabs and briquettes of Vermont marble and Indiana limestone are being used for measurements of surface and water runoff chemistry, as well as surface recession and other changes. Stone deterioration data will be correlated with environmental data recorded at these sites by EPA. In the first year of testing, recessions near 15 micrometers were measured for skyward surfaces of briquettes. Results of the surface chemistry suggest that the direct effect of gaseous sulfur dioxide at skyward surfaces was much less than the effect of acid rainfall. Research on bronze deterioration is limited. A field study is underway of more than 100 bronze plaques from the same foundry and exposed in sites across the northern U.S. since the early 1960s. The amount of corrosion will be correlated with environmental data from nearby monitoring sites.

The NPS is also establishing a network of monitored cultural resources. Intensive monitoring is underway at Mesa Verde National Park, Independence National Historical Park, and, as of mid-1986, Gettysburg National Military Park. As in the stone field exposure program, deterioration and environmental data are being collected and correlated. At Mesa Verde, two test walls built of native sandstone are being used, one fully exposed, one sheltered in the cliff. Field test kits for park managers have been developed for intermittent monitoring at additional sites.

A geographic inventory of cultural properties with respect to pollution regimes is also being conducted to help assess pollution effects. Estimates of the distribution of cultural resources by their size, material,



Dr. Steve Norton from the University of Maine prepares to section a sediment core taken from the bottom of a study lake, Rocky Mountain National Park. The sediments revealed no discernible trend toward increasing acidity over the past 150 years, but growing development in the southern Rocky Mountain region is likely to cause increased acidic deposition in the future.

and location are being prepared from existing documentation. Exposure histories will be estimated from historic emissions and estimated deposition levels.

Protection and mitigation strategies are being evaluated through laboratory and field testing of the long-term performance of stone and other masonry treatments, and through cost comparisons of methods for cleaning masonry structures and bronze statues. The costs will be compiled from actual project costs in northeastern states.